UASLP–IF–00–01

SELEX[1]

Antonio Morelos

Instituto de Física, Universidad Autónoma de San Luis Potosí,
Álvaro Obregón 64, Zona Centro, 78000 San Luis Potosí, México
morelos@ifisica.uaslp.mx

Abstract. A summary of the path which lead to a high energy physics group at Instituto de Física de la Universidad Autónoma de San Luis Potosí is presented. This group is the result of the initial push made by Leon Lederman at the beginning of the 80's.

By mid 80's I started as a graduate student at experiment E761-Fermilab. The first experiment where San Luis Potosí participated is SELEX, experiment dedicated to charm baryon and hyperon studies. In parallel with SELEX another professor joined San Luis Potosí, together with him the group enters into a new challenge in experiment CKM-Fermilab including Ring Imaging Cherenkov technology.

THE HISTORY: E761

Experiment E761, "An Electroweak Enigma: Hyperon Radiative Decays" [1] was my first encounter with experimental high energy physics.

I got experience on silicon micro strip and wire chamber detectors, magnet spectrometers for momentum precision measurements, data acquisition and trigger systems based on NIM and CAMAC, reconstruction and analysis packages, and performed high precision physics measurements of the Σ^+ magnetic moment and of the Σ^+ and $\bar{\Sigma}^-$ production polarization [2–4].

This experiment now represents the starting push for the particle physics group at San Luis Potosí.

[1)] Talk given at the Session honoring Leon Lederman at the VII Mexican Workshop on Particles and Fields, Mérida, México, November 10-17, 1999. Proceedings to be published by AIP.

THE PRESENT: SELEX

There are several aspects to talk about SELEX, recent hyperon and charm physics results, I only highlight a few of them.

Also prior to talk about physics I should mention that E781 or SELEX is the first experiment where San Luis Potosí is a formal collaborating institution. Two students have gotten their master degree thesis related to SELEX, Ricardo López Fernández working in the RICH group and analyzing the beam composition using the RICH, and Galileo Domínguez Zacarías working with the K_s^0 sample looking into π asymmetry [5,6]. Personally I worked in the smart crate controller in the CAMAC setup and trigger installation. An impact at San Luis Potosí also happen in relation to this collaboration: Jürgen Engelfried, member of SELEX and previously WA89 at CERN, accepted to work as professor at San Luis Potosí, his expertise brings more life and conforms the local group and opens more physics opportunities as I'll discuss in the section "The near future".

SELEX is a new fixed target experiment designed to enhance charm - strange baryon over meson data. The data taking lasted from summer 1996 to fall 1997. It includes a tagged hadron beam on π, Σ and proton using a TRD detector; a micro-vertex detector, and particle id using TRD, lead glass, and RICH detectors; all these detectors distributed among three magnet spectrometers [7].

SELEX was designed to be a high x_F charm baryon spectrometer, and in fact this can be appreciated by the high acceptance at $x_F > 0.5$. In the three modes, $\Lambda_c^+ \rightarrow p\,K^-\,\pi^+$, $D^0 \rightarrow K^-\,\pi^+$, and $D^+ \rightarrow K^-\,\pi^-\,\pi^+$, the acceptance is grater than 6 %, and identical for particle and antiparticle decays. The control on the acceptance gives the opportunity to study charm baryon production as a function of x_F with very good precision for challenging theoretical models and other experiments [8–10].

Charm baryon and meson lifetime measurements are also under control in the experiment. SELEX was designed with a trigger to enhance all charm baryon production and decay modes, as a result it has the ability to look for unseen decay modes, right now SELEX is reporting the first observation of Cabibbo suppressed $\Xi_c^+ \rightarrow p\,K^-\,\pi^+$ decay [11].

The fact of having a Σ^- beam to study charm production also provides by its own nature the tool to study properties of the hyperon itself. At present there are preliminary reports on Σ^- radius and total cross section of Σ^- beam on different target material [12–15].

THE NEAR FUTURE: CKM & INSTRUMENTATION

On April 26 1996, Fermilab invited physicists for a workshop towards the use of a 120 GeV/c proton beam on collider and fixed target mode. All mexican groups had the opportunity for joining this activity. The event really represented a great opportunity for young mexican groups since the enterprises are small in size and

with a lot of opportunities to start at the zero point of the design and construction for leading a project or subproject. Of all the mexican existing groups only San Luis Potosí, so far, has taken the challenge to participate actively in one of these experiments.

CKM "Charged Kaons at the Main Injector", a proposal for a Precision Measurement of the Decay $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ and Other Rare K^+ Processes at Fermilab Using the Main Injector, is one of the experiments which were born after the April 96 workshop [16].

The experiment will measure the branching ratio of the ultra-rare charged kaon decay $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ by observing a large sample of those decays with small background. The physics goal is to measure the magnitude of the Cabibbo, Kobayashi, Maskawa matrix element V_{td} with a statistical precision of about 5% based upon a ~ 100 event sample with total backgrounds of less than 10 events. This decay mode is known to be theoretically clean. The only significant theoretical uncertainty in the calculation of this branching ratio is due to the charm contribution. A 10% measurement of the branching ratio will yield a 10% total uncertainty on the magnitude of V_{td}.

In this experiment IF-UASLP is in charge for testing parts and the whole design of two Ring Imaging Cherenkov Counters, RICH's [17]. Experience on this technology came from the participation of Jürgen Engelfried on the design, construction, operation, and analysis of two previous RICH's, one in WA89 and another in SELEX. Also, in SELEX, Ricardo López Fernández, graduate student from IF-UASLP, worked on and used the RICH as part of his M.Sc. thesis.

CKM marks the near future experimental enterprise we are working on at IF-UASLP. We are initiating high energy physics instrumentation at IF-UASLP, aimed right now at the RICH technology applied to the CKM experiment.

HEP: A GROUP AT IF-UASLP

Experimental high energy physics evolves with projects and this aspect is also reflected on the IF-UASLP group which has seen the pass of experiments E761, WA89, E781 and now CKM. Presently, the group is creating a high energy instrumentation laboratory towards detector research and development. The basic idea of the laboratory is to target user defined detectors at world wide experiments, right now we have the RICH design and testing for CKM. In 1999, IF-UASLP just hired Ruben Flores Mendieta to strength particle physics theory and phenomenology research. Looking backwards from the beginning of the 80's to the end of the 90's a spawn of close to 20 years has happened for initiating an experimental group at San Luis Potosí, that is a positive result from an initial kick.

ACKNOWLEDGEMENT

This work was partly financed by IF-UASLP and CONACyT.

REFERENCES

1. E. Jastrzembski et al., Fermilab Proposal 761, An Electroweak Enigma: Hyperon Radiative Decays, April 3, 1985.
2. A. Morelos et al., $p_\perp$ and x_F Dependence of the Polarization of Σ^+ Hyperons Produced by 800 GeV/c Protons, *Phys. Rev. D*, 52, 3777, (1995).
3. A. Morelos et al., Measurement of the Magnetic Moments of Σ^+ and $\bar{\Sigma}^-$ Hyperons, *Phys. Rev. Lett.*, 71, 3417, (1993).
4. A. Morelos et al., Polarization of Σ^+ and $\bar{\Sigma}^-$ Hyperons Produced By 800 GeV/c Protons, *Phys. Rev. Lett.*, 71, 2172, (1993).
5. Ricardo López Fernández, Identificación de Partículas producidas en Interacción p-N mediante el E781 RICH, M. of Sc. Thesis, IF-UASLP, January, 1997, unpublished.
6. Galileo Domínguez Zacarías, Distribución Angular del $K^0_s \rightarrow \pi^- \pi^+$ en E781, M. of Sc. Thesis, IF-UASLP, September 21., 1998, unpublished.
7. R. Edelstein et al., A Proposal to Construct - SELEX - Segmented Large-x Baryon Spectrometer, November 8, 1987.
8. Fernanda G. Garcia, Talk: Wine & Cheese, Fermilab, Batavia, Il, August 27, 1999.
9. Fernanda Garcia, The SELEX Collaboration, First Charm Baryon Physics from SELEX, Proceedings of the 1999 Division of Particle and Fields, UCLA, Los Angeles, California USA, January 5-10, 1999, FERMILAB-Conf-99/070-E.
10. J. Russ et al., First Charm Hadroproduction Results from SELEX, Proceedings of the International Conference High energy physics, Vancouver 1998, vol. 2 1259-1262, hep-ex/9812031.
11. S.Y. Jun et al., Observation of the Cabibbo Suppressed Decay $\Xi_c^+ \rightarrow p\ K^-\ \pi^+$, FERMILAB-PUB-99-217-E, hep-ex/9907062, accepted for publication en Phys. Rev. Lett. 2000.
12. U. Dersch et al., Total Cross-Section Measurements with π^-, Σ^- and protons on Nuclei and Nucleons Around 600 GeV/C, FERMILAB-PUB-99-325-E, hep-ex/9910052, submitted to Nuclear Physics B, Oct 20, 1999.
13. M.A. Moinester et al., Inelastic Electron Pion Scattering at FNAL (SELEX), Proceedings of the 8th International Conference on the Structure of Baryons (BARYONS '98) Bonn, Sept 22-26, 1998, TAUP-2568-99, hep-ex/9903039.
14. V. Kubarovsky et al., Radiative Width or the a(2) Meson, Proceedings of the International Conference High energy physics, Vancouver 1998, vol. 2 1296-1299, hep-ex/9901014.
15. I. Eschrich et al., Hyperon Physics Results from SELEX, Proceedings of the Heavy Quarks at Fixed Target, Batavia 1998, 303-313, hep-ex/9812019.
16. R. Coleman et al., Charged Kaons at the Main Injector, A Proposal for a Precision Measurement of the Decay $K^+ \rightarrow \pi^+\ \nu\ \bar{\nu}$ and Other Rare K^+ Processes at Fermilab Using the Main Injector, submitted to Fermi National Accelerator Laboratory, Batavia, IL, USA, April, 1998.
17. Erik Ramberg et al., CKM Research and Development Project Plan, The CKM Collaboration, submitted to Fermi National Accelerator Laboratory, Batavia, IL, USA, September, 1998.